

# **CHAPTER I**

## **INTRODUCTION**

### **BACKGROUND**

In 2000, the U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region (Reclamation) reinitiated a feasibility investigation to evaluate the potential for enlarging Shasta Dam for increased water supply and operational flexibility. Increases in demands for water supplies and attention to ecosystem needs in the Central Valley of California have renewed interests on expanding the facility. The Shasta Lake Water Resources Investigation (SLWRI) is being conducted at the direction of Congress, and supports other Federal interests within the study area. Expansion of storage in Shasta Reservoir as part of the Central Valley Project (CVP) is one of five potential surface water storage projects identified in an August 2000 Record of Decision (ROD) for the CALFED Bay-Delta Program (CALFED), currently the California Bay-Delta Authority. The ROD identified the potential for expansion of Shasta Reservoir to help increase the pool of cold water available to maintain lower Sacramento River water temperatures needed by certain fish and provide other water management benefits, such as water supply reliability.

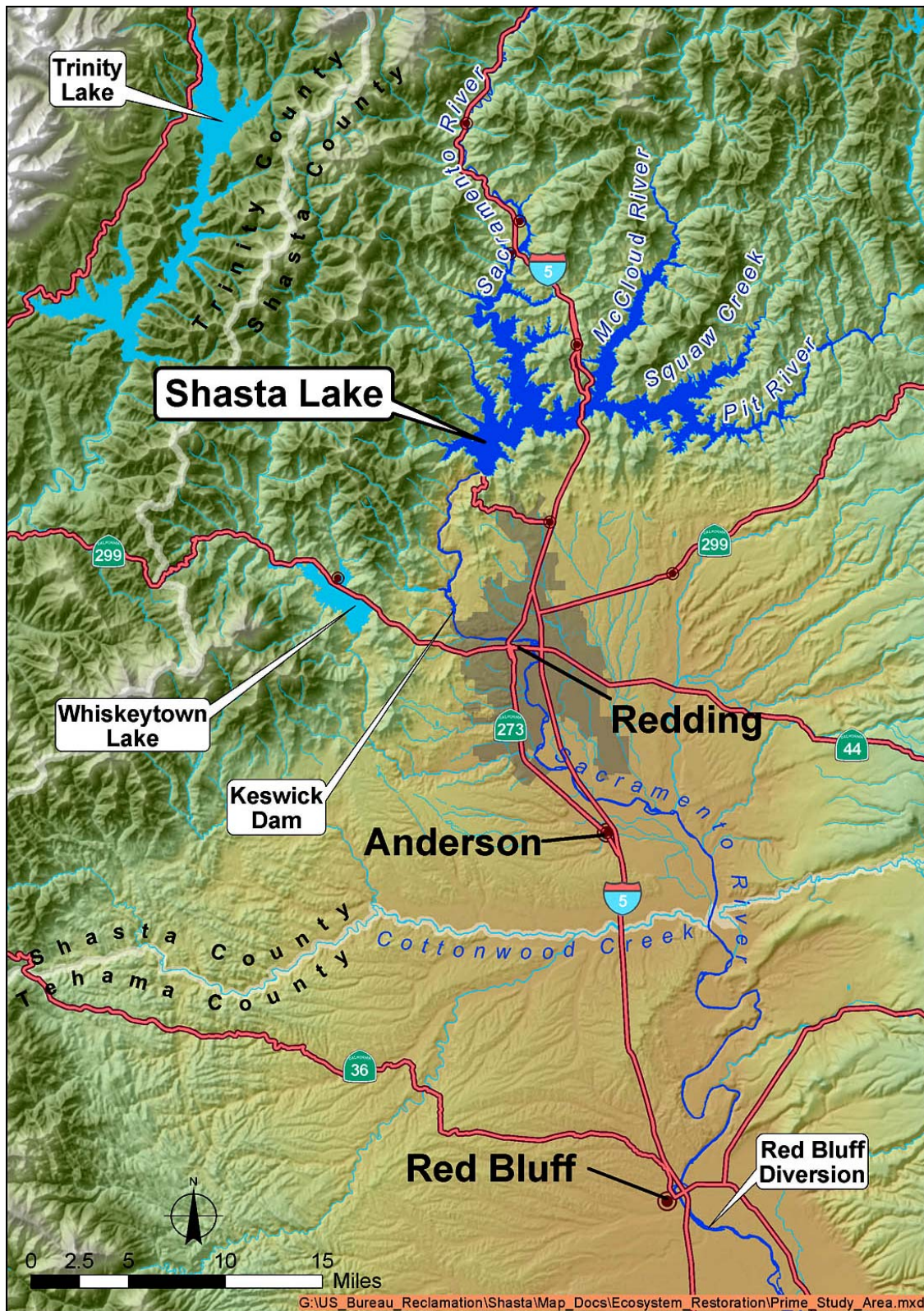
A Mission Statement Milestone Report (MSMR) for the study was completed in March 2003. It outlines the resource problems, study objectives, and mission statement for the SLWRI, and puts forth several concepts to address the identified problems.

### **PURPOSE AND SCOPE**

The primary purpose of this office report is to further identify potential ecosystem restoration opportunities that address the planning objectives of the SLWRI. To the maximum extent practical, features to promote the survival of anadromous fish in the upper Sacramento River and to help restore ecosystem values in the study area are to be incorporated into each alternative plan formulated for the study. The ecosystem restoration measures described herein are developed to a level of detail necessary to determine if they should be considered in alternative plans for the SLWRI.

### **STUDY AREA**

The primary study area includes Shasta Lake and vicinity; the lower reaches of rivers and streams tributary to Shasta Lake, including the Sacramento, McCloud, and Pit rivers; and the Sacramento River downstream from Shasta Dam to about the Red Bluff Diversion Dam (RBDD). The primary study area is shown in Figure 1. The RBDD is the point at which releases from Shasta Dam begin to have a negligible effect on Sacramento River water temperatures and the river landscape changes to a broader, alluvial stream system.



**Figure 1 – Primary Study Area**

Due to the potential for water resources changes at Shasta Dam to have effects outside the primary study area in the Central Valley, the extended study area includes the upper watershed of the Sacramento River; the Sacramento River Basin downstream to the Delta, and the San Joaquin and Tulare Lake basins. Ecosystem restoration opportunities associated with this study will be located within the primary study area. Accordingly, this report does not address conditions throughout the Central Valley extended project area. For the purpose of this document, discussions will be separated into two geographic sub-areas: the Shasta Lake and Tributaries sub-area, and the Sacramento River from Shasta Dam to Red Bluff sub-area.

Land uses in the primary study area are principally agricultural and open space, with urban development focused along highway corridors and in the cities of Red Bluff and Redding. The region has extensive tracts of Federal and State lands, including portions of the Shasta-Trinity, Lassen, Plumas, and Mendocino National Forests. Other public lands include State recreation areas and wildlife management areas.

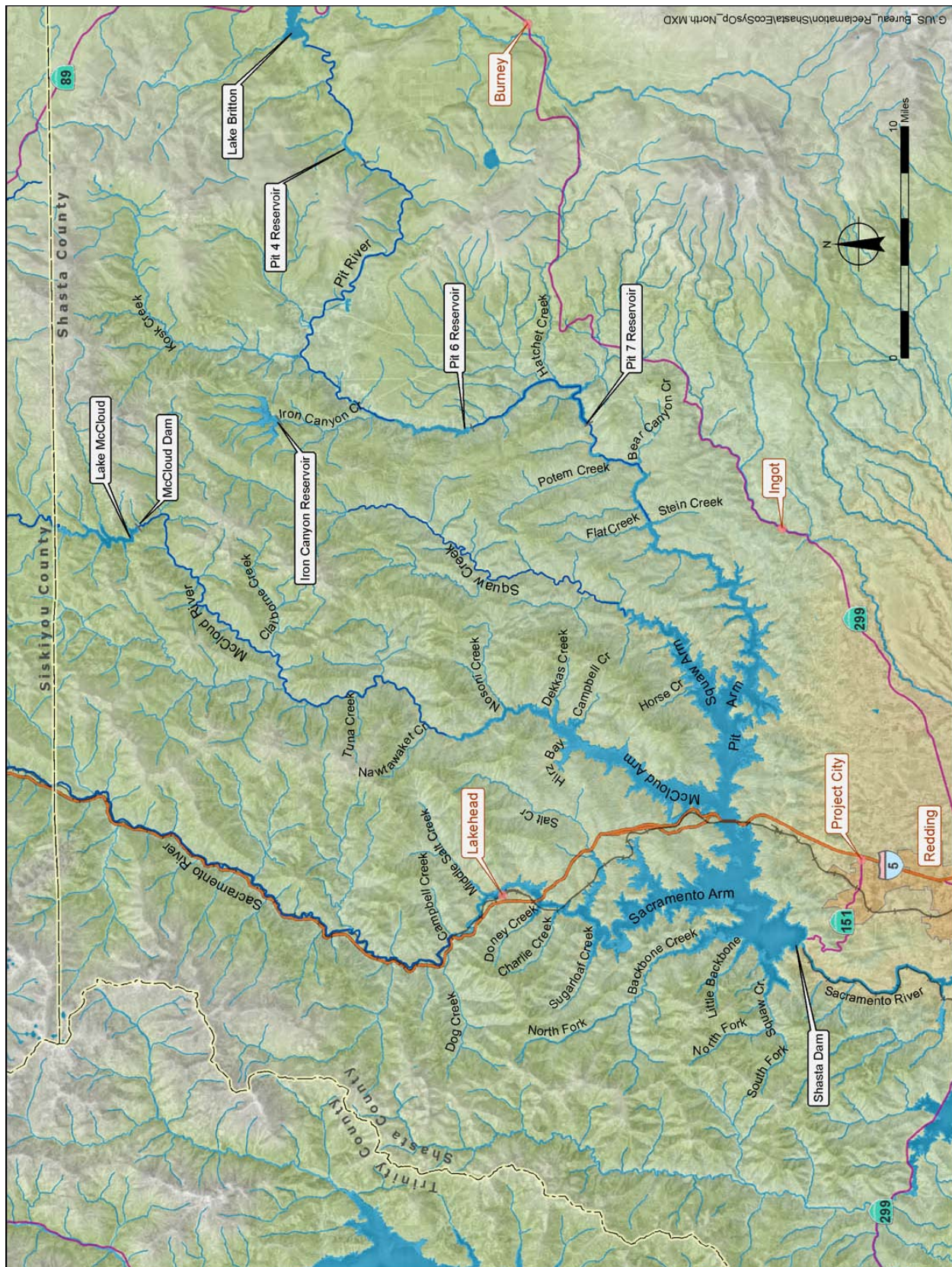
### **Shasta Lake and Tributaries Sub-area**

The Shasta Lake and Tributaries Sub-area is illustrated in Figure 2, and includes Shasta Lake and the lower reaches of its major tributaries. The 533-foot high, 4.55 million acre-feet (MAF) Shasta Dam and Reservoir are located on the upper Sacramento River, about nine miles northwest of the City of Redding. Shasta Lake has about 370 miles of shoreline and controls runoff from about 6,420 square miles, including four major tributaries and numerous minor creeks and streams. Elevations in the watershed range from 1,070 feet at Shasta Lake to more than 14,000 feet on Mount Shasta and more than 10,000 feet in the Warner Range. The four major ‘arms’ of the reservoir, the Sacramento River, McCloud River, Squaw Creek, and Pit River, are described below.

### ***Sacramento River Arm***

The Sacramento River upstream of Shasta Lake drains an area of over 400 square-miles. Its headwaters include the southwestern slopes of Mount Shasta and the Trinity and Klamath Mountains. The river flows south for about 40 miles until it enters Shasta Lake near Riverview (upstream of Lakehead). The river corridor is deeply entrenched in the steep mountain terrain, and flows primarily over bedrock. Tributaries to the Sacramento River Arm of Shasta Lake include Backbone and Little Backbone creeks; West Squaw Creek; Middle Salt Creek; Salt Creek (fed by Nelson, Coal, and Salt creeks); and O’Brien Creek. West Squaw Creek should not be confused with the larger Squaw Creek tributary to Shasta Lake that enters from the east. Minor tributaries include Shoemaker Gulch, Butcher Creek, Alder Creek, Elmore Creek, Little Sugarloaf Creek, Sugarloaf Creek, Indian Creek, Gregory Creek, Lick Gulch, and Frost Gulch.





**Figure 2 – Shasta Lake and Vicinity**

### ***McCloud River Arm***

The McCloud River Arm consists of a deep canyon that was inundated by Shasta Lake after construction of Shasta Dam. Tributaries to the McCloud Arm of Shasta Lake include Goat, Ycotti, Keluche, Hirz, Ellery, Nosoni, Dooles, Mathles, Dekkas, Campbell, Curl, Marble, and Potter creeks. The McCloud River basin drains an area of over 600 square-miles in Shasta and Siskiyou counties. The river flows southwesterly from its headwaters at Colby Meadows for approximately 50 miles to its terminus at Shasta Lake. Snowpack and glaciers on Mount Shasta provide the principal source of flow for the McCloud River. The free-flowing stretches of the McCloud River are protected under the California Wild and Scenic River Act (Public Resources Code Section 5093.50), although the Act does not declare it Wild and Scenic. The Wild and Scenic legislation made the following recommendations for the McCloud:

- The continued management of the river resources in their existing natural conditions represents the best way to protect the unique fishery of the McCloud River, and
- Maintaining the McCloud River in its free-flowing condition to protect its fishery is the highest and most beneficial use of the waters of the McCloud River within the segment from 0.25 miles below McCloud Dam to the McCloud River Bridge.

McCloud Dam was constructed upstream from Shasta Lake as part of the Pacific Gas and Electric (PG&E) McCloud-Pit project. The lower McCloud River is highly regulated by this reservoir, which diverts approximately 75 percent of McCloud River flows into the Pit River by way of Iron Canyon Reservoir. The river above Lake McCloud is relatively flat, while the lower McCloud River runs through a deep bedrock canyon.

### ***Pit River and Squaw Creek Arms***

The 4,700 square-mile Pit River watershed extends into northeastern California and southeastern Oregon. The North Fork of the Pit River originates at the outlet of Goose Lake, and the South Fork originates in the south Warner Mountains in Lassen County. The main stem of the Pit River is formed by the junction of its North and South Forks near Alturas. The Fall River joins the Pit River in the western portion of the watershed. There are over twenty named tributaries to the Pit River system, totaling about 1,050 miles of perennial streams. Tributaries to the Pit River Arm of Shasta Lake include Jones River; Cove, Azelle, Fort, Reynolds, Dead Horse, and Arbuckle creeks; and Brushy, Reno, Murphy, Browns, Sugarpine, Dark, Blue, Panther, and Wildcat canyons. There are several hydropower facilities and diversions that affect seasonal flows in the Pit River.

The Squaw Creek watershed is located east of Shasta Lake and drains over 100 square miles. The terrain is primarily steep and includes over 108 miles of perennial streams. Tributaries to the Squaw Creek Arm of Shasta Lake include: Zinc Creek, Town Creek, Lick Canyon, Museum Canyon, Flume Canyon, Frenchman Gulch, and McClure Gulch.

## **Sacramento River from Shasta Dam to Red Bluff Sub-area**

The Shasta Dam to Red Bluff Sub-area consists of the Sacramento River corridor and lower reaches of its tributaries between Shasta Dam and Red Bluff, as shown in Figure 3. Downstream from Shasta Dam, the Sacramento River flows through a narrow, rock canyon before entering the broader floodplain of the northern Central Valley near Redding. There are three major water control structures between Shasta Dam and Red Bluff: Keswick Dam, the Anderson-Cottonwood Irrigation District (ACID) Diversion, and the RBDD. Keswick Dam is located approximately 10 miles downstream from Shasta Dam and the ACID diversion dam is located near Redding. The ACID diversion is gravity-fed and removes an average of 300 cubic feet per second (cfs) from the Sacramento River between April and October. The RBDD is located in Red Bluff and diverts water to the Tehama Colusa and Corning canals.

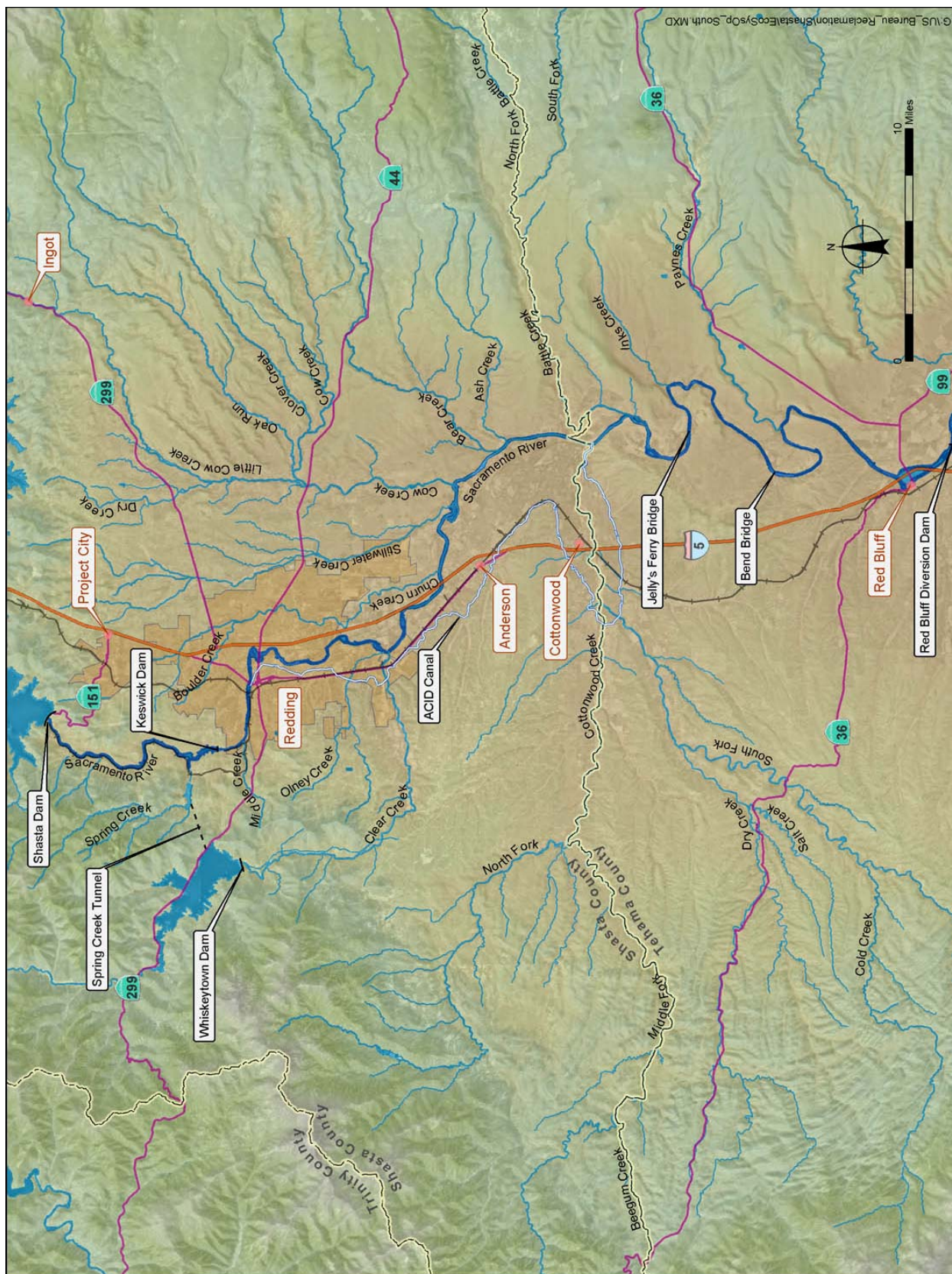
Major tributaries to the Sacramento River within the sub-reach include Clear Creek, Battle Creek, Cow Creek, and Cottonwood Creek. Minor tributaries include Olney, Ash, Bear, Churn, Stillwater, Inks, and Paynes creeks. None of the tributaries between Keswick Dam and Red Bluff are controlled by major dams, with the exception of Whiskeytown Dam on Clear Creek. However, there are numerous smaller impoundments and diversion structures that affect flows on the tributaries. The reach of the river between Keswick Dam and Balls Ferry flows through the most urbanized portion of the study area, the communities of Redding and Anderson, and is subject to urban encroachment in floodplain areas.

Clear Creek is the first major tributary downstream from Keswick Dam, entering the Sacramento River from the west about 12 miles downstream from the dam. Whiskeytown Reservoir on Clear Creek was created as part of the Trinity River Division of the CVP in December of 1963, and was designed to divert water from the Trinity River Basin to the Sacramento River for the purpose of power generation and water supply. All but about 13 percent of the flows in Clear Creek are diverted through the Spring Creek Tunnel into the Sacramento River above Keswick Dam. Minor tributaries to lower Clear Creek include Dog Gulch, Orofino Gulch, Paige Boulder Creek, Kanaka Creek, South Fork Clear Creek, Andrews Creek, Little Kanaka Creek, Stony Gulch, and Niles Canyon.

Cow Creek flows into the Sacramento River from the east and ranks third, behind Cottonwood Creek and Stony Creek, for producing the largest peak inflows to the Sacramento River within the northern Sacramento Valley. There are eight hydroelectric facilities and over 190 water diversions in the Cow Creek watershed. Major tributaries to Cow Creek include Little Cow Creek, Oak Run Creek, Clover Creek, Old Cow Creek, and South Cow Creek. Elevations in the watershed range from 350 feet to over 7,300 feet.

Battle Creek originates in the Cascade Mountains and drains the western slopes of Mount Lassen. The creek flows through several narrow canyons before its confluence with the Sacramento River downstream from the Balls Ferry Bridge. The Coleman National Fish Hatchery is located near the mouth of Battle Creek and is the largest chinook salmon fish hatchery in the world. There are numerous water diversion and hydropower facilities in the Battle Creek stream system that can significantly alter flows during the dry season.





**Figure 3 – Sacramento River between Shasta Dam and Red Bluff**

Cottonwood Creek is the largest uncontrolled tributary to the Sacramento River north of the Sacramento-San Joaquin Delta. It originates in the northeastern slopes of the Coast Range and the southeastern slopes of the Trinity Mountains, with watershed elevations ranging from 8,000 feet in the mountains to 150 feet near the mouth. Peak flows in Cottonwood Creek can exceed 90,000 cfs during severe floods. Tributaries include the North Fork Cottonwood Creek, Beegum Creek, and the South Fork Cottonwood Creek. Rainbow Lake, created by Misselbeck Dam in 1920, is the only major reservoir in the watershed and has a capacity of 4,800 acre-feet.

## MISSION STATEMENT AND FORMULATION PROCESS

Six water resources problems and needs were identified in the MSMR. They included (1) anadromous fish survival problems in the upper Sacramento River, (2) water supply reliability needs in the extended study area, (3) ecosystem restoration needs in the primary study area, (4) residual flood problems along the upper Sacramento River, (5) hydropower needs in California, and (6) water-oriented recreation needs in Northern California. From these problems, primary and secondary planning objectives were developed for the SLWRI:

- Primary Objectives
  - Increase the survival of anadromous fish populations in the Sacramento River primarily upstream from the Red Bluff Diversion Dam.
  - Increase water supplies and water supply reliability for agricultural, M&I, and environmental purposes to help meet future water demands with a primary focus on enlarging Shasta Dam and Reservoir.
- Secondary Objectives

To the extent possible through pursuit of the primary planning objectives, include features to help:

- Preserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River.
- Reduce flood damages along the Sacramento River.
- Develop additional hydropower capabilities at Shasta Dam.

From these planning objectives, and considering a set of constraints, guiding principles, and evaluation criteria, a mission statement for the study was developed as follows:

*To develop an implementable plan primarily involving the enlargement of Shasta Dam and Reservoir to promote increased survival of anadromous fish populations in the upper Sacramento River; increased water supply reliability; and to the extent possible through meeting these objectives, include features to benefit other identified ecosystem, flood control, and related water resources needs.*



Alternatives developed during the planning process will likely consist of a combination of several measures to address the primary and secondary study objectives consistent with the mission statement. Individual measures or potential components of an alternative need not address all of the study objectives by themselves. Ecosystem restoration measures, at minimum, should address the primary objective to increase the survival of anadromous fish populations and, to the extent possible, the secondary objective to preserve and restore ecosystem resources in the Shasta Lake area and along the upper Sacramento River. Because the SLWRI was initiated specifically to examine opportunities to enlarge Shasta Dam and Reservoir, ecosystem restoration measures should complement potential storage increases at Shasta Dam or be closely connected to the area of influence of such actions. Measures should not preclude or act contrary to other study objectives unless these negative impacts can be mitigated.

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